# PATENT SPECIFICATION

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Complete Specification Accepted: March 7, 1939.

501,865

COMPLETE SPECIFICATION

## Process of Making Glass Articles having Optically Accurate Surfaces and Articles Produced thereby

We, CORNING GLASS WORKS at Foot of Walnut Street, Corning, New York, United States of America, a corporation of the State of New York, United States of America Assignees of ANNA ROYALL LEBBY, a citizen of the United States of America of Route 1, Charleston, South Carolina, United States of America, legal representative of the States Lee Lebby (deceased) a citizen of the United States of America, late of Corning, New York, United States of America, under Letters of Administration dated 22 March 1937 issued by the Surrogates Court, in the County of Steuben, State of New York, United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:

This invention relates to the making of glass articles with optically accurate surfaces.

In the ordinary process of pressing glass, molten glass is introduced into the mold bottom after which a plunger enters the mold to shape the charge of hot molten glass previously introduced. In the manufacture of ordinary ware, the temperature at which the mold elements are run is of little importance, except that it must be kept below the point at which molten glass would stick to the metal during the formation of the article, for if the plunger is permitted to run sufficiently hot, the molten glass will adhere thereto and upon retraction of the plunger the article will be deformed. Likewise it is essential to maintain the mold bottom below any temperature to which glass would be likely to adhere thereto. As a result of this practice it is not unusual for the surface of the glass coming into contact with the mold parts to be distorted through shrinkage. Consequently it has heretofore been necessary, where optically accurate surfaces are required, to grind and polish them in order to preserve their integrity. Such grinding and polishing of the glass surfaces is a slow and expensive process and does not lend itself to high speed mass production such as is demanded today with the result, except in instances where absolute accuracy is essential, the use of glass optical elements such for instance as reflectors for automobile headlamps, has found but little application.

The primary object of the present invention is to facilitate the production of glass articles having optically accurate surfaces without necessitating the expensive grinding and polishing processes heretofore thought to be necessary, and thus increase the scope of utility of glass in fields where its use has heretofore found but restricted application.

According to the present invention those portions of the mold contacting the optically important areas are caused to run sufficiently cooler than those surfaces of the mold which contact the optically unimportant areas, that the glass contacting the cooler surfaces will be caused to set before the portion of the glass forming the optically unimportant areas becomes too stiff to flow and thus gives way to shrinkage and like distortion, all of the surface of the article being pressed to finished form by contact with the wall of the mold.

In the drawings:

Figure 1 is a sectional view through a glass reflector having an internal optically accurate surface in the form of a parabola such as is commonly used in headlights of motor vehicles.

Fig. 2 is a vertical sectional view through a mold and plunger in which a reflector such as that disclosed in Fig. 1 may be produced;

Fig. 3 is a horizontal sectional view taken on the lines 3-3 of Fig. 2;

Fig. 4 is a side view of a glass reflecting unit commonly referred to in the art as a reflex button in which the objective and reflective areas are made optically accurate;

Fig. 5 is a vertical sectional view through a mold used for producing the reflecting unit illustrated in Fig. 4; and

Fig. 6 is an enlarged horizontal sectional view taken on the line 6-6 of Fig. 5.

In carrying the invention into practice there is used a mold bottom 10 constituting an outer shell 11 having an insert 12

[*Price* 1/-]

which is preferably formed of a metal of comparatively low thermal conductivity and is spaced from the wall of the shell 11 by means of a dead air space 13. While it is desirable that the mold cavity 14 conform to the shape of the optically accurate surface to be produced on the article of glassware or reflector so as to avoid undue thick and thin portions in the finished product, it is not essential that the wall of the mold cavity be made with extreme accuracy. Fitted on the mold bottom 10 above described is a mold ring 15 which serves to limit the flow of glass upwardly when the plunger to be hereinafter described enters the mold.

The plunger 16 includes a glass contacting plunger head 17 which is accurately formed to the proper contour for contact with the surface of the glass which is to be optically accurate. This plunger head is secured to a stem 18 and may be hollow as at 19 and connected by means of passages 20 and 21 in the plunger stem with fluid intake and exhaust pipes 22 and 23 by which cooling fluid may be caused to circulate through the plunger head so as to maintain it at a proper temperature to cause the glass coming in contact therewith to rapidly set before that glass which contacts with the wall of the mold cavity becomes too stiff to yield and compensate for shrinkage and like distortion.

It will be noted that all the surface of the glass reflector made by the apparatus described is press molded to shape by contact with mold walls, and the advantage is obtained that the reflector is given its final shape for assembly in a lamp structure without grinding or polishing.

In the production of reflecting units such as those illustrated in Fig. 4, a mold is used such as that illustrated in Fig. 5. This mold 24 constitutes a mold body 25 provided with a mold cavity 26 comprising an aperture extending entirely through the mold body. The bottom of this mold cavity is formed by an insert 27 preferably composed of a material having higher heat conductivity than the material from which the mold body 25 is made. Openings 28 extend into the mold 25 parallel to the cavity but spaced a short distance therefrom so as to produce a relatively thin wall adjacent that portion of the cavity which contacts with the optically unimportant surfaces of the glass being formed therein. Cooperating with the mold body 25 is a mold member 29 which like the mold body is formed with a cavity 30 which extends throughout its thickness and is closed at the end opposite that which opens into the cavity 26 by an insert 31 formed of a material having higher heat conductivity than that from which the member 29 is formed. The ends 32 and 33 of the inserts 27 and 31, respectively, are accurately shaped so that glass coming into contact therewith will assume a proper and accurate optical contour to produce the reflecting unit illustrated in Fig. 4. By reason of the fact that the inserts 27 and 31 are formed of a material of relatively high thermal conductivity, the surfaces 32 and 33 will run relatively cool and conduct the heat away from the glass coming in contact therewith at a more rapid rate than will the surfaces of the cavities 26 and 30, thus preserving the fluidity of the glass contacting the sides of the mold and confining any shrinkage or distortion which may occur in the glass body to the optically unimportant areas of the unit and thus preserve the integrity of the optically important surfaces of the article.

Typical mold materials having widely differing coefficients of thermal conductivity are cast iron, with a coefficient of .13 in c.g.s. units, and stainless steel (13% chromium content) with a coefficient of .04.

While the mold operating temperatures will vary with different glasses and with different shaped articles, they may be described generally in terms of their effect on the glass. The plunger or part forming the optical surface should be run as cold as possible without checking the glass, while the mold or parts forming the optically unimportant surfaces should run as hot as possible without causing the glass to stick. These temperatures will vary during the molding cycle and refer to the temperature of the parts as they first contact the glass. Actually, the plunger will be heated above the mold temperature before it is withdrawn from the glass. In the formation of the reflectors shown in Fig. 1, the glass is introduced at about 1000°C. and the plunger and mold have initial temperatures in the neighbourhood of 400°C. and 475°C., respectively. While this may seem like a relatively slight difference, the plunger is completely surrounded by the glass and exerts a greater cooling action thereon than the outer mold surface. The probable maximum differential of temperature is 200°C.

We are aware that presses for glass are known in which the plunger is provided with means for water cooling and we make no general claim to novelty in a press of that type.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to

be performed, we declare that what we claim is:—

1. A process for the manufacture, by pressing in a mold, of glass articles having optically accurate surfaces, wherein those portions of the mold contacting the optically important areas of the article are caused to run sufficiently cooler than those surfaces of the mold contacting the optically unimportant areas that the glass contacting the cooler surfaces will be caused to set before the portion of the glass forming the optically unimportant areas becomes too stiff to flow and thus give way to shrinkage and like distortion, all of the surface of the article being pressed to finished form by contact with the wall of the mold.

2. A process according to claim 1 in which the mold surfaces contacting the optically important areas are maintained at a cooler temperature by means of a fluid cooling medium, or by being made of more heat-conductive material than the mold surfaces in contact with optically unimportant areas of the article.

3. A press mold for making a glass article by the process of claim 1 or 2 comprising a wall portion shaped to give the contacting area of the molded article a desired optical configuration and a wall portion for producing the optically unimportant surfaces of the article, the first mentioned wall portion having cooling means associated therewith or being made of more heat-conductive material than the second mentioned wall portion.

4. A press mold according to claim 3 having internal air space in its wall portions for producing the optically unimportant surfaces of the article.

5. A glass article made by the process claimed in claim 1 or 2 and having a pressed optically important surface and a pressed optically unimportant surface containing substantially all the surface defects caused by shrinkage during formation of the article, the entire surface of said article being press molded to final form.

6. The process of making glass articles having optically accurate surfaces, as herein described and illustrated in Figs. 2, 5 and 6 of the accompanying drawings.

7. The press molds for making glass articles having optically accurate surfaces, as herein described and illustrated in Figs. 2, 5 and 6 of the accompanying drawings.

Dated this 31st day of January, 1938.

For the Applicants,
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Chartered Patent Agents,
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London, W.C.2.

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[This Drawing is a reproduction of the Original on a reduced scale.]

Fig. 1

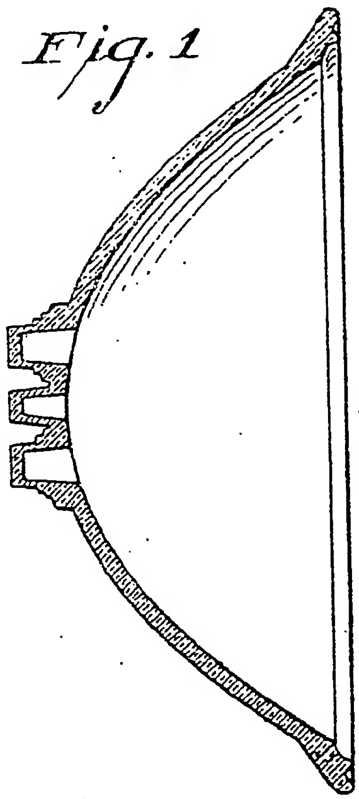


Fig. 3

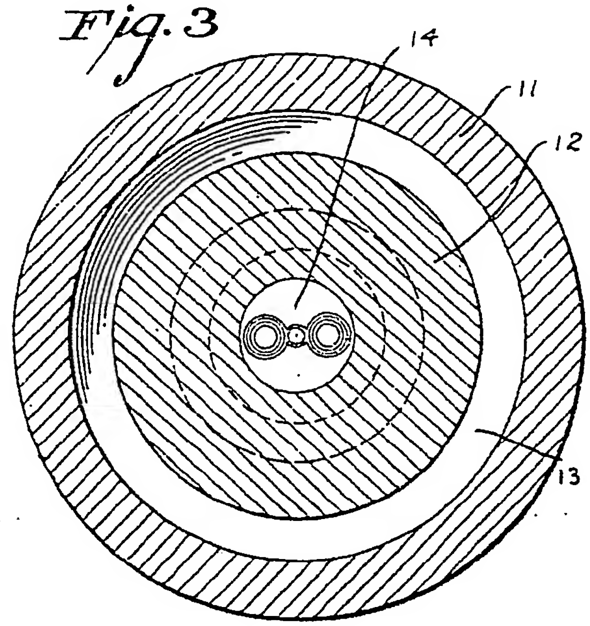



Fig. 2

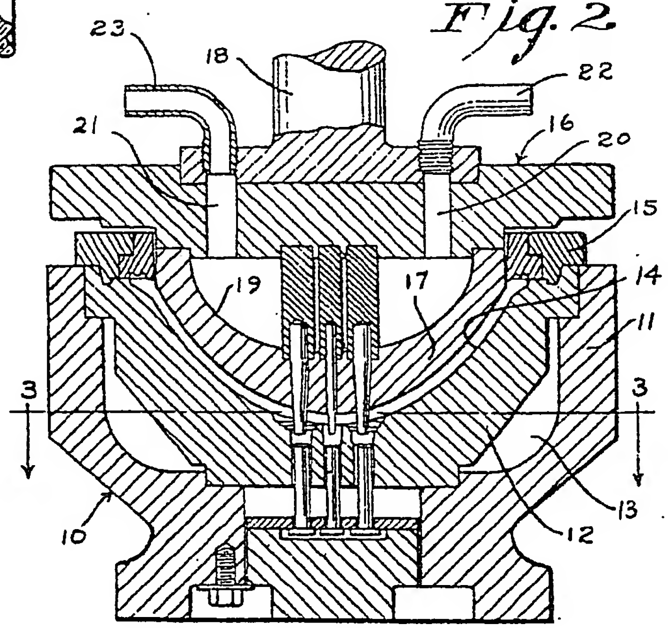
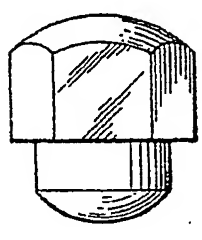



Fig. 4



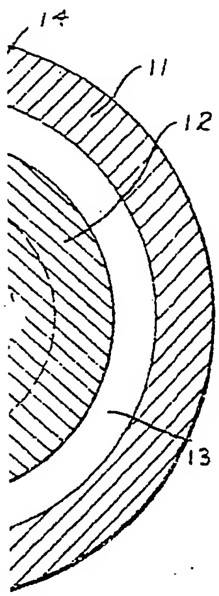



Fig. 2

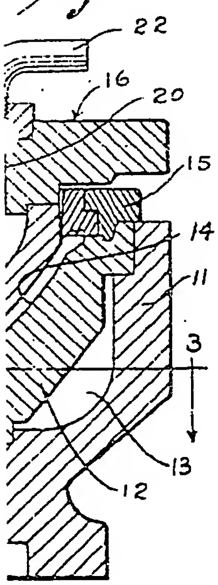



Fig. 5

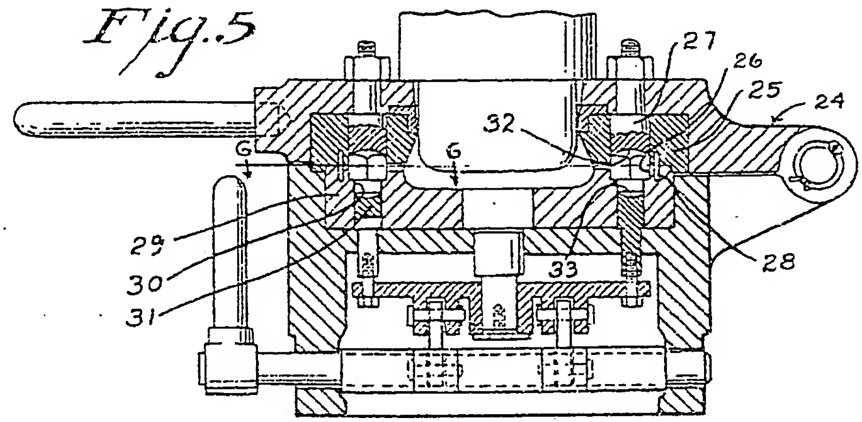



Fig. 6

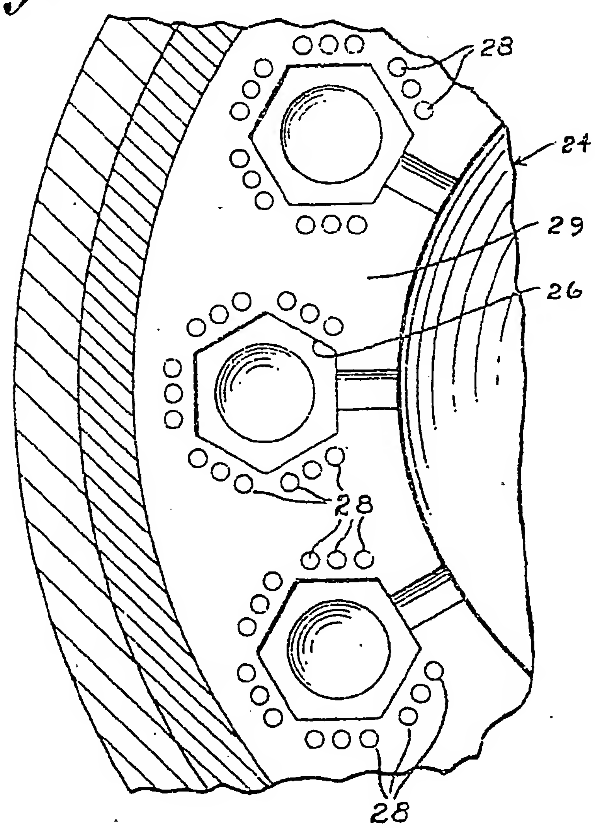



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Fig. 1

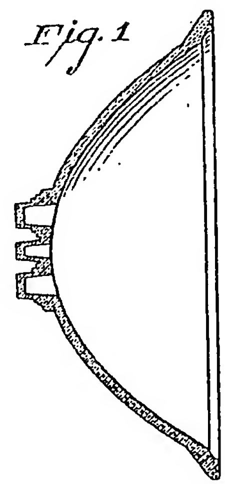


Fig. 3

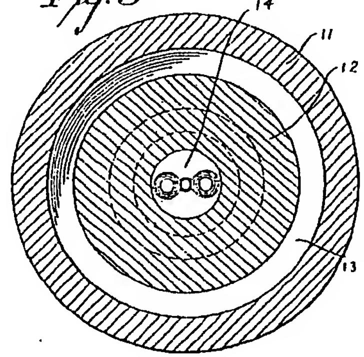



Fig. 4

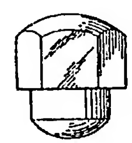


Fig. 2

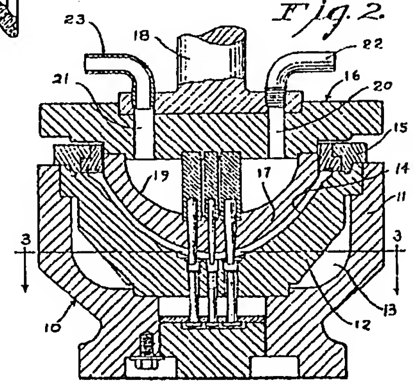



Fig. 5

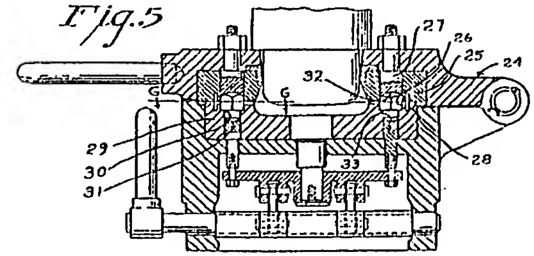
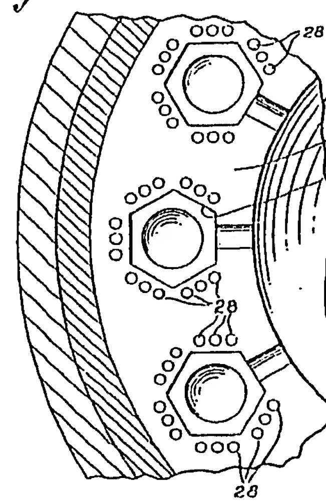



Fig. 6

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